13.—A preliminary account of the vegetation of Loch McNess, a swamp and fen formation in Western Australia

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Abstract

Loch McNess is a body of fresh, alkaline water situated in the Yanchep National Park, Western Australia. It is extensively overgrown by vegetation, and sedge swamp and sedge fen formations can be recognised, which are similar floristically and structurally to those in other Australian States and abroad. These formations are bordered by communities dominated by *Melaleuca* or *Banksia*.

Introduction

The purpose of this communication is to describe the vegetation associated with Loch McNess, a body of fresh water situated in the Yanchep National Park (Jenkins 1964; Jenkins *et al.* 1964). The region studied lies in a depression some 31 miles to the north of Perth, and four miles from the coast, where the annual rainfall is about 27 inches (Little 1965). The depression is in limestone country, and may be a karst feature formed by the collapse of underground caverns (McArthur and Bettenay 1960). The general features of the area are depicted in Figure 1, and the distribution of the main types of vegetation is shown in Figure 2.

The area investigated may be divided into three sections. The eastern section, of 40 acres, is extensively overgrown with sedge communities and contains little open water. It has been variously interfered with, the aerial photographs revealing "cropping marks" which result from attempts in the 1930's to establish playing fields†. The limestone ridge to the east contains caves which are of considerable local interest, and water drains from this region through the eastern, and into the southern section of the Loch. The southern section, some 66 acres, consists largely of open water as described in the first published account of "Lake Yanchep", as it was then known (Milligan 1903). Part of the area was deepened by dredging between 1936 and 1940; rowboats may be hired, and a launch takes visitors around the dredged channel at the periphery of the open water.

The extensive northern section, 375 acres, is largely covered with vegetation, as noted by Milligan (1903). The northern and southern sections are separated by a region of shallow water, across which silt and earth were dumped in the late 1930's and again in the 1950's to form a causeway. A shallow channel exists near to the western end of the causeway, and a bridge was partly constructed across this channel in about 1939, but never completed. *Melaleuca* trees, present girth at breast height up to 113 cm were not cleared from the approaches to the bridge. Access to the northern section may be had by boat from the south, though even in winter progress is greatly impeded by sedges and shallow water, the channels in some regions being narrow and difficult to locate. A track suitable for four-wheel-drive vehicles runs parallel to each side of the northern section, but the fringing vegetation makes access to the water difficult. The northern section has been burned, at least in part, every three to four years since about 1940, in an effort to check the growth of vegetation.

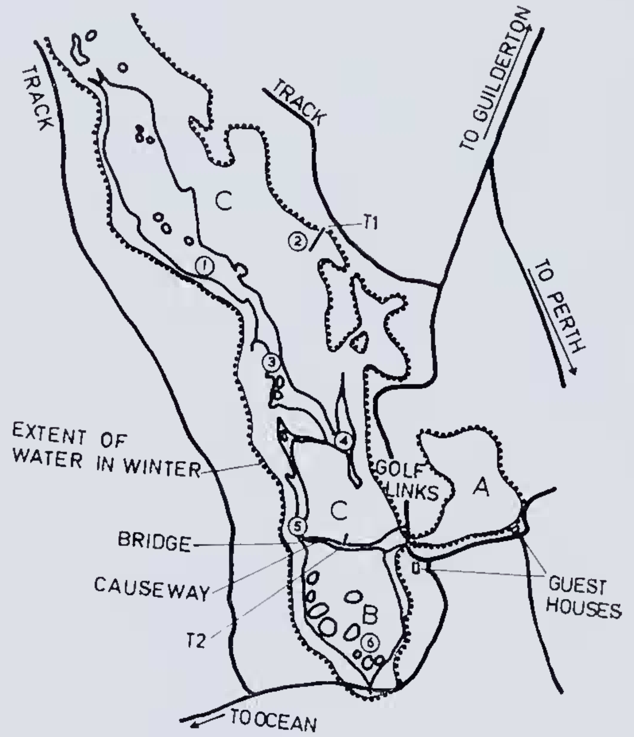

Figure 1.—The general features of Loch McNess, drawn from an aerial photograph. A, B, and C are the eastern, southern, and northern sections respectively. The numbers 1 to 6 represent the sites from which water samples were taken for pH and resistance measurements. T_1 and T_2 are the sites of the transects depicted in Figure 5 and Figure 6 respectively.

Description

Open water.—The three sections include approximately 134 acres of open water. Water drains into the Loch from the surrounding limestone hills, and overflows into caves at the southern end and at least one point in the northern section. The water level is fairly constant, but may rise by some 20 cm. above the normal level in an exceptionally wet season‡. No movement could be seen in the water apart from a gentle flow between the eastern and southern sections, and at the point where water drains from the Loch to the south.

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† We are indebted to the Secretary of the National Parks Board for the historical information included in the paper.

‡ Information supplied by the Secretary of the National Parks Board.

Samples of water were collected in September from the sites indicated by the numbers 1-6 in Figure 1, and transferred to the laboratory for measurements of pH and electrical resistance, using a Pye pH meter and a Metrohm Conductivity Apparatus. Results are presented in Table 1, along with data for Perth tap water and sea water. The water is alkaline and fresh. Even within the sedge communities of the northern section, 320 metres from open water, the pH was not lower than 7.6.

The water is on the whole remarkably clear, though often cloudy in the southern section, where boating disturbs the bottom. In the northern section the water in winter is typically 20 to 50 cm deep in open regions, and the smooth, greenish-grey bottom appears deceptively firm. However, every movement of an oar lifts a cloud of black, loosely-compacted organic debris to drift slowly and settle gently, and it is possible to sink an oar vertically into this deposit to a depth of 80 cm without effort. A sample of the upper 5 cm of deposit was found to consist of many fragments of epidermis and other plant debris, small dark particles taken to be at least in part fragments of charcoal, diatom frustules, a few strands of blue-green algae and *Spirogyra,* unicellular green algae and Protista. Diatoms and blue-green algae were much more prevalent in a bottom sample taken from beneath water sheltered by *Melaleuca* trees.

TABLE 1

Estimates of pH and electrical resistence of water samples from Loch McNess. The numbers correspond with the sites shown in Figure 1. Tap water and sea water are included for comparison.

Sample	pH	Resistance (Ohms)
1 Northern section	7·7	....
2 Northern sedge community	7·6	....
3 Northern section	8·1	1620
4 Northern section	7·6	1670
5 Near bridge	7·6	1770
6 Southern section	8·0	1850
University tap water	....	1320
Sea water	....	20

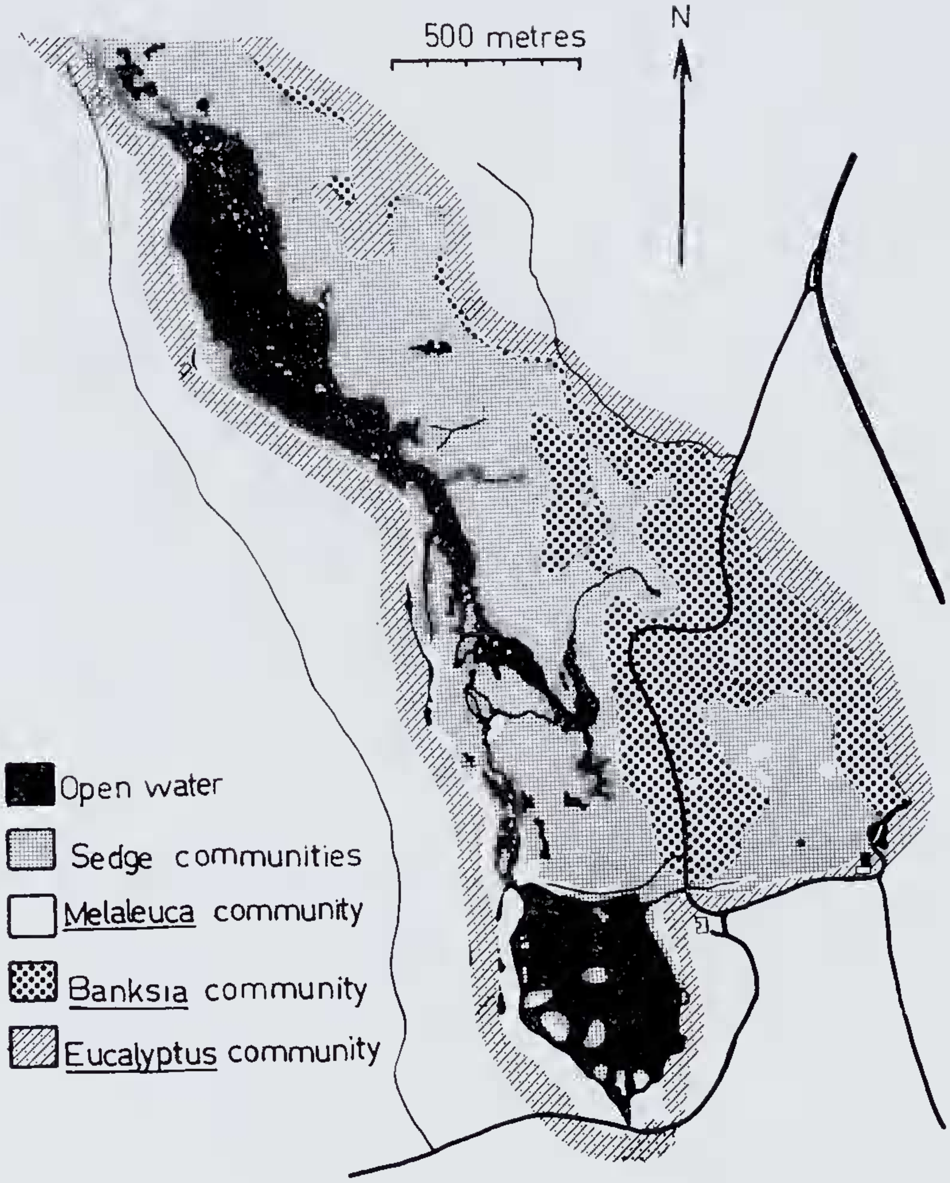

Figure 2.—The general distribution of vegetation in the Loch McNess region, compiled from an aerial photograph and field observations. The extent of the *Eucalyptus* woodland is not shown.

Occasionally drifts of *Spirogyra* are observed, and in some regions there occur small patches of *Chara*, usually densely covered with *Spirogyra*. No aquatic vascular plants were observed in the open water, though the floating *Lemna minor* occurs in the sedge communities, and *Azolla* and *Spirodela* have been recorded for the area (Smith and Marchant 1961).

Species present.—A list of the vascular species encountered is presented in Table 2, and a collection of the sedge species has been incorporated into the Herbarium of the Botany Department, University of Western Australia. Species which occur only in the *Banksia littoralis* and *Eucalyptus gomphocephala* communities have not been included in the table. The plants known to be introduced to the State were collected exclusively from the disturbed southern and eastern sections.

TABLE 2

Vascular plants recorded from Loch McNess.

PTERIDOPHYTA

Polypodiaceae

Pteridium esculentum (Forst. f.) Nakai

Azollaceae

**Azolla filiculoides* Lam.

ANGIOSPERMAE

Monocotyledoneae

Cyperaceae

Carex appressa R. Br.
Carex fascicularis Sol. ex Boott (formerly included in *Carex pseudocyperus* L.)
Cladium arthrophyllum (Nees) F.v.M.
Cyperus tenuiflorus Rottb. (formerly included in *Cyperus rotundus* L.)
Gahnia trifida Labill.
Lepidosperma drummondii Benth.
Lepidosperma gladiatum Labill.
Lepidosperma longitudinale Labill.
Machaerina articulata (R. Br.) Koyama (= *Cladium articulatum* R. Br.)
Machaerina juncea (R. Br.) Koyama (= *Cladium junceum* R. Br.)
Machaerina laxa (Nees) Koyama (= *Cladium laxum* (Nees) Benth.)
Schoenus andrewsii W. V. Fitzg.
Schoenus indutus (F.v.M.) Benth.
Schoenus rodwayanus W.V. Fitzg.
Schoenus unispiculatis (F.v.M.) Benth.
Scirpus cernuus Vahl.
Scirpus nodosus Rottb.
Scirpus validus Vahl. (formerly included in *Scirpus lacustris* L.)

Iridaceae

Patersonia occidentalis R. Br.

Juncaceae

Juncus bufonius L.
Juncus capitatus Weig.
Juncus pallidus R. Br.
Juncus planifolius R. Br.

Lemnaceae

Lemna minor L.
**Spirodela oligorrhiza* (Kurz) Hegelm.

Liliaceae

Wurmbaea dioica (R. Br.) F.v.M.

Orchidaceae

Diuris pauciflora R. Br.
Thelymitra pauciflora R. Br.

Poaceae

†*Arundo donax* L. *var. versicolor* (Miller) Stokes
†*Cortaderia argentia* (Nees) Stapf.
Cynodon dactylon (L.) Pers.
†*Holcus lanatus* L.
†*Paspalum dilatatum* Poir
†*Polypogon monospeliensis* (L.) Desf.
Sporobolus actinocladus (F.v.M.) F.v.M.

Restionaceae

Lepyrodia muirii F.v.M.
Loxocarya flexuosa (R.Br.) Benth.

Scheuchzeriaceae

Triglochin procera R. Br.
Triglochin striata Ruiz. *et* Pav.

Typhaceae

Typha angustifolia L.

Xanthorrhoeaceae

Xanthorrhoea preissii Endl. in Lehm.

Dicotyledoneae

Aizoaceae

Carpobrotus aequilaterus (Haw.) N. E. Brown

Apiaceae

Apium australe Thou.
Centella asiatica (L.) Urb.

Asteraceae

Cotula coronopifolia L.
Embergeria megalocarpa (Hook *f.*) Boulus (= *Sonchus megalocarpus* (Hook *f.*) Black)
Senecio aff. lautus Forst. *f. ex.* Willd.

Chenopodiaceae

Rhagodia preissii Moq.

Geraniaceae

†*Geranium molle* L.
Pelargonium capitatum (L.) L'Herit *ex* Ait.

Goodeniaceae

Dampiera trigona De Vriese
Scaevola nitida R. Br.

Haloragaceae

Haloragis brownii (Hook *f.*) Schindler

Lauraceae

Cassytha racemosa Nees

Mimosaceae

Acacia cyanophylla Lindl.

Myoporaceae

Myoporum tetrandrum (Labill.) Domin (= Myoporum serratum R. Br.)

Myrtaceae

Eucalyptus rudis Endl.
Melaleuca rhaphiophylla Schau.

Onagraceae

Epilobium billardierianum Ser. (formerly included in *Epilobium glabellum* (Forst f.) Black)

Papilionaceae

†*Psoralea pinnata* L.
Templetonia retusa (Vent.) R. Br.
Viminaria denudata Sm.

Polygalaceae

Comesperma virgatum Labill.

Polygonaceae

Polygonum serrulatum Lag.

Proteaceae

Banksia littoralis R. Br.

Ranunculaceae

Ranunculus lappaceus Sm.

Rhamnaceae

Trymalium spathulatum (Labill.) Ostf.

Rutaceae

Phebalium anceps D.C.

† Introduced species.
* Recorded by Smith and Marchant (1961) but not seen during the present survey.

As can be seen from the table, sedges make up a large proportion of the species; there are 18 Cyperaceae, as compared with four Juncaceae, the family which has the second-largest number of native species present. Of these four Juncaceae none is abundant, and *Juncus pallidus*, *J. bufonius* and *J. capitatus* are limited to the disturbed southern regions. In contrast, sedges dominate some 315 acres of the vegetation.

Vegetation fringing open water.—The sedge communities encroach upon the open water from the margins. Several important fringing species are encountered, but *Scirpus validus* is by far the most common, and forms very dense mats of vegetation in the northern section (Fig.3). Where the water is shallow, it appears that the rhizomes grow out more rapidly under the surface of the organic debris, forming less dense stands, *Lepidosperma drummondii* is also a common fringing species, often occurring between stands of *Machaerina articulata* and open water (Fig.4), but only rarely between *Scirpus validus* and open water. *Machaerina juncea* and *Machaerina laxa* are also present as fringing species, and in some regions of deeper water may build up protruding shelves of densely packed rhizomes. In the extreme southern area

Figure 3.—*Scirpus validus* fringing open water in the northern section. The tips of the culms are approximately 1.5 metres above the water level. The water is 20 cm deep. In the background can be seen further stands of *Scirpus validus,* with *Viminaria denudata* and *Eucalyptus gomphocephala* behind.

Figure 4.—Open water fringed by a narrow band of *Lepidosperma drummondii* with, behind, dense stands of *Machaerina articulata*. The *Machaerina* tips rise some 2.5 metres above water, which is 20 cm deep.

of the Loch a community of *Melaleuca rhaphiophylla* occurs at the edge of the main body of open water.

Vegetation of the sedge communities.—The large areas labelled in Figure 2 as "sedge communities" consist of a complex mosaic of vegetation, variously dissected by pools and sluggish waterways. Profile drawings of transects running into typical areas of sedge vegetation illustrate this complexity (Figs.5&6). Within the sedge communities regions of deeper water, some 40cm in winter, are occupied by dense stands of *Scirpus validus* and *Machaerina articulata* (Fig.5). Some regions are richer in species. For example north of the causeway (Fig.6), where the water level is 30 cm in winter, but at or below ground level by the end of summer, *Typha angustifolia, Machaerina laxa* and *Machaerina* *juncea* are also common, and there are small patches of more-or-less open water. *Machaerina juncea* forms meadows in regions where the water is even more shallow in winter (7 cm on the transect line, Fig.5). The meadows are typically 70 cm tall, and the density of living culms was estimated from one quadrat to be 4,400 per square metre. In these meadows shrub species are established, and even seedlings of *Banksia littoralis* (Fig.7).

Lepidosperma gladiatum grows very prolifically in some regions, especially towards the border between the sedge communities and the adjacent woodland (Fig.5), where it may form pure stands up to three metres in height, which are quite impenetrable. The species also occurs on adjacent land, and in water to a depth of approximately 50 cm in winter.

The fringing Melaleuca *community.—Melaleuca rhaphiophylla* dominates a narrow community fringing some areas of sedge vegetation, particularly in the southern section (Fig. 2), where it may be associated with *Eucalyptus rudis*. The transect depicted in Figure 6 passes through a narrow fringe of *Melaleuca*. It can be seen that *Melaleuca* seedlings become established among the sedges and, if they are not killed by fire, presumably survive to extend the *Melaleuca* community. The seedlings appear quite vigorous but are few in number. Beneath the trees species of the sedge communities are eliminated, presumably because of shading. The *Melaleuca* trees also occur on soil which is just below or above the winter water level, and in these regions *Gahnia trifida* is common, while *Polygonum serrulatum* occurs in sheltered pools.

Other fringing communities.—The higher land surrounding the Loch carries a woodland dominated by *Eucalyptus gomphocephala D.C.* The banks of the Loch rise more steeply on the western side, and the *Eucalyptus* is there separated from the sedge vegetation by a fringe of *Melaleuca* or shrubs such as *Viminaria*. The slope of the eastern bank is more gentle, and the *Eucalyptus* woodland is separated from the sedge vegetation by a woodland of *Banksia littoralis*. Part of a *Banksia* community is included in Figure 5. In this community occur many large plants of *Xanthorrhoea preissii*, which are particularly common near to the border of the sedge vegetation. The trunks of the *Banksia* and *Xanthorrhoea* plants are fire scarred.

Discussion

A comparison of Loch McNess with similar formations in other temperate regions.—The sedge communities of Loch McNess may be divided into two distinct types. Firstly, there is the swamp vegetation, occurring in the deeper water, and characterised by *Scirpus validus* and *Machaerina articulata*. Secondly, there are the "sedge meadows" dominated by *Machaerina juncea*, in which the water level is just above the peat surface in winter, and below the surface in summer; this formation, comprising sedge and alkaline peat, is a true fen (Tansley 1939). The general appearance of the vegetation is very similar to that of swamp and fen formations in other parts of the world (Weaver and Clements

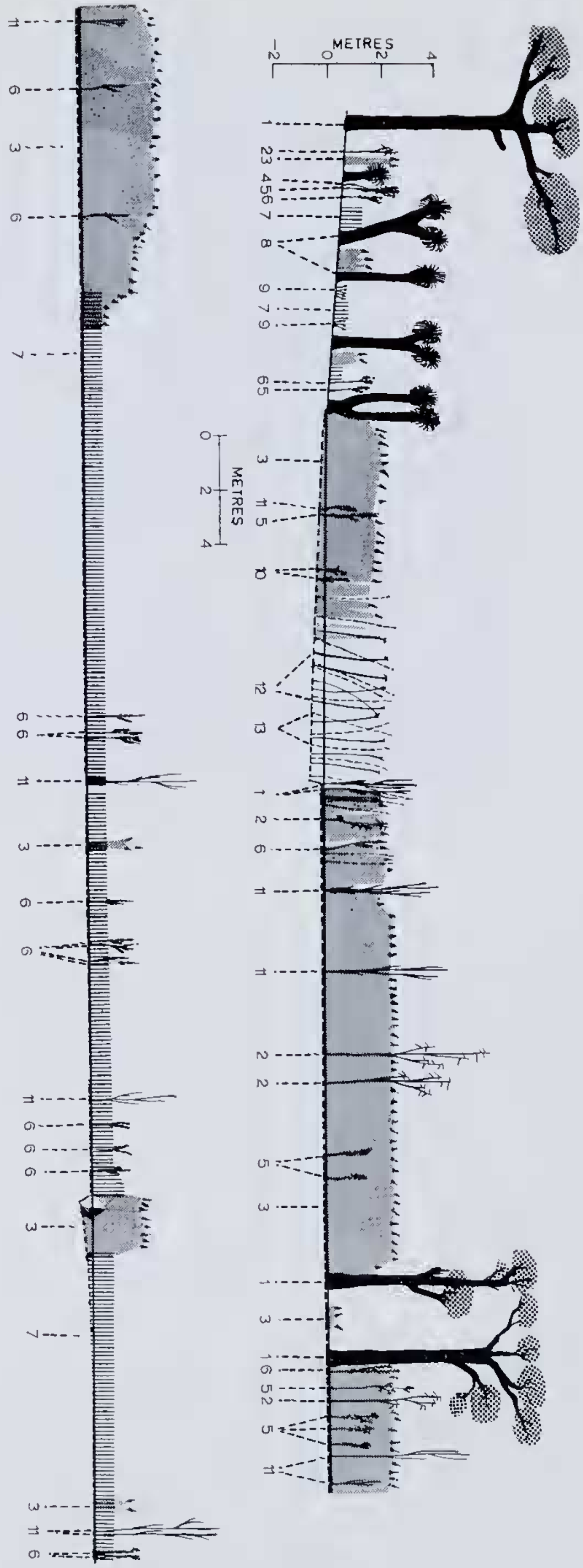

Figure 5.—Profile drawing made from a transect through *Banksia* and sedge communities. The transect was one metre wide, and in the position T_1, Fig. 1. No attempt has been made to indicate the number of sedge culms. Key to species: 1. *Banksia littoralis*. 2. *Acacia cyanophylla*. 3. *Lepidosperma gladiatum*. 4. *Hardenbergia comptoniana*. 5. *Templetonia retusa*. 6. *Phebalium anceps*. 7. *Machaerina juncea*. 8. *Xanthorrhoea preissii*. 9. *Scirpus nodosus*. 10. *Machaerina laxa*. 11. *Viminaria denudata*. 12. *Scirpus validus*. 13. *Machaerina articulata*. Zero on the vertical scale represents the water level in winter.

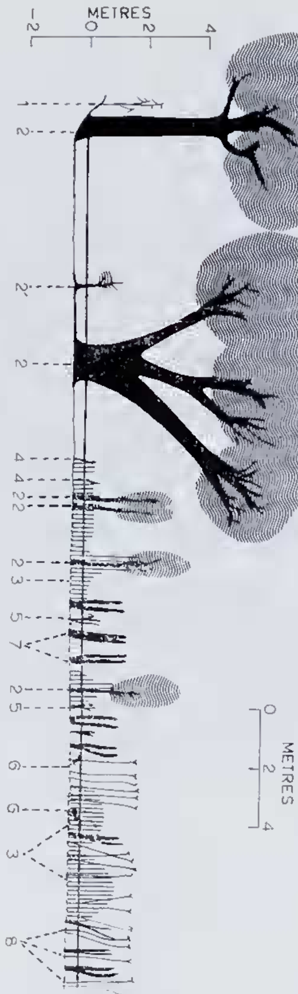

Figure 6.—Profile drawing made from a transect through *Melaleuca* and sedge communities. The site of the transect is marked T_2 in Fig. 1. The transect was one metre wide except for the *Melaleuca* trees, which were approximately two metres from the transect lines. No attempt has been made to indicate the number of sedge culms. Key to species: 1. *Acacia cyanophylla*. 2. *Melaleuca rhaphiophylla*. 2. *M. rhaphiophylla, moribund*. 3. *Machaerina juncea*. 4. *Triglochin procera*. 5. *Machaerina laxa*. 6. *Polygonum serrulatum*. 7. *Typha angustifolia*. 3. *Scirpus validus*. Zero on the vertical scale represents the water level in winter.

1938; Tansley 1939; Pidgeon 1940; Eardley 1943; Martin 1960a,b). In addition, it is probable that the *Melaleuca* community is analagous with the "carr" of the European fenlands (Tansley 1939; Eardley 1943).

Among the species occurring naturally at Loch McNess there is 35% endemism, as compared with approximately 75% for the flora of the south-west vegetation province of Western Australia (Gardner 1959), emphasising the general observation that swamps and fens characteristically include species of cosmopolitan distribution (Diels 1906; Muenscher 1944). Eardley (1943) presents a table in which species occurring in the Eight-mile Creek Swamp of South Australia are matched against comparable species for Europe and North America, while Martin (1960b) includes, in his account of the South African Groenvlei, a similar comparison between the species of Groenvlei and those of Europe. Data from these two tables are included in Table 3 for comparison with species at Loch McNess. The floristics of Loch McNess are clearly quite similar to those of Eight-mile Creek, where 24% of the Loch McNess species, and 38% of the genera, also occur.

Table 3 also includes prominent species of cosmopolitan distribution, which are not represented in Loch McNess. Of these, *Eleocharis acuta* and *Scirpus americanus* may well prove to be present, since they are recorded for the State (Blackall 1954). The absence of *Phragmites communis* is of some interest. This species, although of cosmopolitan distribution, and stated in Floras of other States as being present "throughout Australia", is in fact not native to the State. Gardner (1952) notes that it has been recorded at Albany, where it is apparently introduced. (*Phragmites karka* (Retz.) Trin. *ex* Steud. occurs in the north of the State.) *Cladium procerum* is also absent from the State.

Viminaria denudata is common at Loch McNess, but absent from Eight-mile Creek, even though it is present in neighbouring South Australian swamps. Eardley suggests that high pH may preclude the species, but its occurrence at Loch McNess does not support this suggestion, since the pH of the two regions is very similar. *Lepidosperma gladiatum* is also a prominent species at Loch McNess, but absent from Eight-mile Creek, though present in South Australia. It seems quite possible that the dense fringing stands of this species at Loch McNess are favoured by burning; Eight-mile Creek Swamp had not been burned before the vegetation survey, though it has since been drained and cleared (Eardley 1943).

Plant succession at Loch McNess.—In general, succession in vegetation associated with freshwater lakes proceeds from open water to swamp community, then to fen, which is invaded by fen "carr", and finally woodland (*e.g.* Tansley 1939). Although it is not possible to draw definite conclusions from the present preliminary examination of the Loch McNess vegetation, it does appear that the succession follows this general pattern, and the following suggestions may reasonably be made. It is clear that no, or extremely few, plants are able to invade the open water by becoming established as seedlings on the bottom, even though the water is in some regions quite shallow. It is likely that this is because of the very deep, light mud, in which it would be difficult for seedling establishment to take place and in which, once established, a young seedling would be easily choked by deposition of disturbed sediment or the growth of algae. Invasion of the loose mud occurs from the fringes, chiefly by *Scirpus validus* which, together with associated species, is responsible for a considerable accumulation of organic debris. This slowly compacts to build up a layer of peat towards the water surface. (Churchill (1961) records 310 cm of peat on one of the southern islands of the Loch.)

Once a compact bottom has been formed near to the water surface, conditions become favourable for the establishment of other species such as *Typha angustifolia* and *Machaerina juncea*, and the type of community included in Figure 6 is formed. This may be invaded by *Melaleuca*.

Figure 7.—The establishment of *Banksia littoralis* in a sedge meadow. The young *Banksia* plant is approximately 2 metres in height. The *Machaerina juncea* meadow is fringed by *Viminaria denudata* and *Lepidosperma gladiatum*.

TABLE 3

The distribution of cosmopolitan swamp and fen species and genera. Data for Eight-mile Creek Swamp (South Australia) from Eardley (1943), for Groenvlei (South Africa) from Martin (1960b), for European swamps in general from Tansley (1939) supplemented by Clapham et al. *(1962), and for American swamps in general from Weaver and Clements (1938), Meunscher (1944), and Mason (1957). The comparison is based largely upon the tables given by Eardley (1943) and Martin (1960b), and includes some nomenclatural changes from Eichler (1965) and Blackall and Grieve (1965).*

Western Australia (Loch McNess)	South Australia (Eight-mile Creek Swamp)	South Africa (Groenvlei)	Europe	North America
Carex fascicularis (formerly included in *C. pseudocyperus*) and *Carex appressa*	*Carex fascicularis*	other *Carex* species	other *Carex* species	*Carex pseudocyperus* and other *Carex* species
....	*Cladium procerum* (formerly included in *C. mariscus*)	*Cladium mariscus* var. *jamaicensis*	*Cladium mariscus*	*Cladium mariscoides* and *C. jamaicensis*
....	*Eleocharis acuta*	....	*Eleocharis palustris*	*Eleocharis palustris*
Gahnia trifida	*Gahnia trifida*	....	....	....
Machaerina articulata (= *Cladium articulatum*)	*Machaerina articulata*	....	....	....
Machaerina juncea (= *Cladium junceum*)	*Machaerina juncea*	....	....	....
Scirpus nodosus	*Scirpus nodosus* and *S. americanus*	*Scirpus americanus* (= *S. pungens*)	*Scirpus americanus*	*Scirpus americanus*
Scirpus validus	*Scirpus validus*	*Scirpus littoralis*	*Scirpus lacustris*	*Scirpus validus*
Juncus pallidus, *J. capitatus*, *J. bufonius* and *J. planifolius*	*Juncus pallidus* and *J. caespiticius*	*Juncus dregeanus*	other *Juncus* species	other *Juncus* species
Lemna minor	*Lemna minor*	....	*Lemna minor*	*Lemna minor*
Triglochin procera	*Triglochin procera*	....	....	....
Triglochin striata	*Triglochin striata*	*Triglochin striata*	....	*Triglochin striata*
....	*Phragmites communis*	*Phragmites communis*	*Phragmites communis*	*Phragmites communis*
Typha angustifolia	*Typha angustifolia*	*Typha angustifolia* and *T. capensis*	*Typha angustifolia* and *T. latifolia*	*Typha angustifolia* and *T. latifolia*
Cotula coronopifolia	....	*Cotula coronopifolia*	....	*Cotula coronopifolia*
Senecio aff. *lautus*	*Senecio* aff. *lautus*	*Senecio lautus* and *S. elegans*	*Senecio aquaticus*	other *Senecio* species
Centella asiatica (= *Hydrocotyle asiatica*)	*Hydrocotyle verticillata* (formerly included in *H. vulgaris*)	*Hydrocotyle verticillata*	*Hydrocotyle vulgaris*	*Hydrocotyle verticillata* and other *Hydrocotyle* species
Epilobium billardierianum (formerly included in *E. glabellum*)	*Epilobium billardierianum* and *E. pallidiflorum*	*Epilobium flavescens* and *E. hirsutum*	*Epilobium hirsutum* and other *Epilobium* species	other *Epilobium* species
Polygonum serrulatum	*Polygonum serrulatum*	*Polygonum salicifolium*	*Polygonum lapathifolium* and *P. minus*	*Polygonum lapathifolium* and other *Polygonum* species

As the peat level continues to rise in the sedge vegetation, *Machaerina juncea* becomes dominant, and the fen formation is established. Invasion by dicotyledons such as *Viminaria, Phebalium* and *Banksia* then occurs. Transition to *Banksia* woodland as such, including the fringing *Xanthorrhoeas,* is presumably a very slow process, since this community occurs only on ground which is at a rather higher level than the fen. It is probable that the *Banksia* communities shown in Figure 2 have become established on areas which have never supported sedge communities, as well as in areas in which the peat has become sufficiently compact to support the accumulation of windblown sand and other debris. The fate of the *Melaleuca* community is equally uncertain, but it is possible that the accretion of soil may ultimately take place to such an extent as to make conditions unsuitable for the swamp paperbark, allowing the establishment of *Eucalyptus* woodland.

The position is further complicated by the possibility that the water level of the Loch may have been slowly rising, following a possible amelioration of climatic conditions after an arid period in Early-Recent times (Crocker 1959). Eardley (1943) has suggested that the Eight-mile Creek Swamp was slowly flooding because of increased rainfall in South Australia, and that the plant communities were showing a succession in which the swamp species were replacing woodland. An inverted succession of this kind may have occurred at Yanchep, but it must be remembered that a point has been reached at which the basin overflows. It is not known when the water level reached this point, but the occurrence of *Banksia* and *Melaleuca* seedlings in the swamp and fen communities suggests very strongly that succession is occurring in the direction open water to sedge community to woodland.

Another complication is afforded by the observation that within the large area of sedge communities there is a mosaic of different vegetation, and also marked irregularities in water depth. In some regions there are pools or what appear to be overgrown channels, while in other regions the change in topography is more subtle. One wonders if there may be changes of a cyclic nature in the communities, the *Machaerina* meadows being built up above the general level of the peat, but later collapsing or eroding back to allow the establishment of communities of deeper water. As mentioned above, the northern section of the Loch vegetation has been burned every three to four years since 1940, and no doubt by accident before that time. Irregularities in the severity of burning could establish important differences, not only in the species present in particular regions, but also in peat topography. A study of the ecological significance of fire in this region would be valuable.

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